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NOTICES OF The Aëronautical Society of Great Britain.

At a meeting of the Council of the Aëronautical Society of Great Britain, held at the Society of Arts, John Street, Adelphi, on March 14, 1905, the following were elected members of the Society:—

MRS. EDWARDS.

MR. E. C. HAWKINS, J.P.

MR. KEITH MACAULAY, R.E.

The concluding meeting of the 40th Session will be held at the Society of Arts in July next, the date of which will be duly announced. On this occasion, Captain Robert Falcon Scott, R.N., M.Aër.Soc., Commander of the *Discovery*, hopes to be present, and to address the Society on "The Use of the Balloon in the Recent Antarctic Expedition." Amongst the papers will be "Some Remarks on Aërial Flight," by Mr. F. H. Wenham, Honorary Member of the Aëronautical Society of Great Britain, and "Balloon Varnishes," by Mr. Walter F. Reid, C.E., F.I.C., F.C.S., M.Aër.Soc.

THE LIBRARY.

The Library is open to members during the session for reference and the borrowing of books on the first Monday of the month, from 2 to 5 p.m., unless notice is given to members of change of date. The following publications have been presented to the Library:—

By the Editor of "Knowledge and Illustrated Scientific News," "The Science Year Book (1905)."

By Colonel F. C. Trollope: Publications of the International Aëronautical Commission (January and June and September, 1903).

By Messrs. Spon & Co.: "The Resistance of Air and the Question of Flying," Arnold Samuelson.

By Herr W. Kress: "Aviatik."

ANNUAL SUBSCRIPTIONS.

Members of the Aëronautical Society of Great Britain who have not yet paid their subscriptions for the current year are reminded that their subscriptions became due

on January 1st last, and are requested to forward the same to the Honorary Secretary, 53, Victoria Street, Westminster, S.W. The attention of those members is called to Rule IVa., by which the privileges of members only extend to those who have paid their subscriptions for the current year.

ERIC STUART BRUCE,

Honorary Secretary.

GENERAL MEETING.

The second meeting of the 40th Session of the Aëronautical Society of Great Britain was held at the Society of Arts, John Street, Adelphi, on Tuesday, March 14th, 1905. The President, Major B. Baden-Powell, occupied the chair.

The PRESIDENT: Gentlemen, the Honorary Secretary will now read the minutes of the last meeting.

The HON. SECRETARY read the minutes.

The HON. SECRETARY: I have the pleasure of announcing that our President has had the generosity to offer a prize of £10 for a Model Flying Machine of 1 lb. weight that will fly for a distance of at least 100 yards and accomplish the distance twice over, with a short interval between, in different directions so as to insure it not being merely carried by the wind. Major Baden-Powell has asked the Council of the Aëronautical Society of Great Britain to undertake the management of the competition, which will take place in about a year's time, and also to elect a jury. I may say that in order to try to facilitate the competition and save expense to the Society, I shall be very pleased to place my ground at Sunningdale, Ascot, at the disposal of the Society for that event. This is merely a preliminary notice. The rules and conditions for carrying out the competition will be published in due course. All communications respecting this competition should be addressed to the Honorary Secretary, Aëronautical Society of Great Britain, 53, Victoria Street, Westminster, S.W.

I have the pleasure to announce that the first balloon journey from London to Paris has been made by a honorary member of the Aëronautical Society of Great Britain, M. Jacques Faure. On Saturday, February 11 last, M. Faure and M. H. Latham started in a balloon from the Crystal Palace Grounds, the wind being N.W. After the departure the balloon was allowed to drop to within a few yards of the sea in order to employ the Hervé water drag. The crossing was made at the rate of about 70 miles an hour, and the Dieppe Lighthouse was seen at 10 p.m. There was no remarkable incident until the balloon landed at St. Denis at 1.30 a.m. This voyage has been described as a piece of luck, but this is hardly an adequate description. I can speak from a personal knowledge of M. Jacques Faure and his methods. There is no doubt that the success of his balloon journeys is largely due to his careful study of the aërial currents and the weather forecasts. The obtainment of weather forecasts now enables such journeys to be undertaken with considerably less risk and greater chances of success than in those days when our knowledge of the weather was the observation of the passing moment.

Notes on Some Recent Experiments in Aërodynamics.

By P. Y. ALEXANDER, M. Aër. Soc.

On the occasion of the launching of the first balloon in Italy, a very interesting discussion was raised with regard to raising surfaces in the atmosphere and propelling them downwards — as to whether we experienced the same resistance. Professor Hergesell, of Strasburg, very kindly arranged for some experiments to be carried out. The apparatus was rigged up, and we tried spheres and discs of varying diameters; but with the spheres we were very much bothered, and I may say our chief trouble was with the vertical currents in the tower of the Cathedral. However, the experiments are still going on, and so far we have found that the spheres rise vertically quicker than they descend. It is rather difficult to understand this. It may be because as the sphere, which was a skin balloon, was rising, the air inside was expanding and blowing the balloon out very tight, and possibly took out wrinkles and other obstructions, the air passing over the surface; but with the discs themselves, as far as we went, we found they practically rose and fell at the same speed. I have not

noticed any experiments of this description, and I thought the matter was worth bringing before the Society.

The PRESIDENT: Though this is an interesting fact which Mr. Alexander has brought forward, from the title of the paper, I was very much in hopes that we were going to hear a few more remarks about Aërodynamics, and I thought, perhaps, this would be a good opportunity of announcing a little result that I obtained from experiments, which, I may as well say at once has nothing very much to do with what Mr. Alexander has said. It is as regards the general forms of aëroplanes as used in gliding machines. I have found from repeated experiments that the ordinary form of aëro-curve, such as that used by Langley, Chanute, and others, concave underneath and convex above, always has a tendency to turn over. It is always liable to dive forward. I believe this may account for a good many of the mishaps and non-success of this form of apparatus. Now if the front or anterior edge be curved downwards, and the after or posterior edge be turned upwards, a very steady and stable glider results. The fore and aft section is like a flattened S, or Hogarth's "line of beauty."

The extent to which the posterior edge can be turned up without detriment is somewhat surprising. I have sometimes so turned it round as to form a distinct concavity to the line of advance, and yet the model has glided forward at a considerable speed, and with great steadiness (models exhibited). I will not now go into the aërodynamical principles involved. I have not investigated that subject very carefully, but I hope on some future occasion to do so.

The Shape of Navigable Balloons.

BY ERIC STUART BRUCE, M.A., F.R.Met.Soc.

Is the navigable balloon worth improving? That is a question which is frequently asked by the general public. Now there are many of us who, with reason, feel convinced that the ultimate future solution of the problem of aërial navigation will be found to be in the body heavier than air—the aëroplane—and some will doubtless say that it is waste of time to endeavour to improve what appears only capable of improvement within only finite limits, that all our united efforts should be directed to the system which, when certain first principles are successfully applied, will not display those boundary lines to further progress which seem so apparent in the case of navigable balloons.

But there are others who, while they admit the limitations of the navigable balloon, and of the possibilities of the aëroplane, yet point out that at the present moment if we want to journey in the air for pleasure, sport, or research, no aëroplane can be found that will do for us what the balloon can. If we wish to make an aërial trip such as M. Faure did a few weeks ago from the capital of this country to the capital of France, it is not a case of choice whether it is to be done by balloon or aëroplane. For the latter is undeveloped, and we must, with humility, confess still useless for a practical purpose. These persons will say that until what is in theory the better system has ceased to be in embryo, we are bound for the sake of those who wish to use the air for travel, discovery, and as a vantage point in war, to do the best we can to improve an imperfect instrument. Perhaps this is the soundest answer to the question. If so, it becomes the duty of a society like this, while it endeavours to encourage every experiment with the aëroplane that may hasten its fitness to supplant the balloon, yet not to withhold its sympathy from those who are trying to improve a temporary expedient.

The surest way to effect improvements in any industry is by comparing past results. A sufficient number of experiments with navigable balloons have already been made to supply material for several papers dealing with various points in navigable balloon construction and engineering, such as the motive power used, the propellers, their shape, size, speed, and position, the steering apparatus, the material used for the gas envelope, the varnish to render it impermeable, the stability of the respective airships, their speed, and the wind forces overcome. All these points are subjects which might well be commented upon by experts and discussed by our members.

But I propose this evening to take as a subject only one point in the construction of a navigable balloon, viz., the shape of the gas envelope. It is apparent that its shape is one of the most vital points in a navigable balloon, for it is imperative that

a form should be imparted to it that will evade its resistance to the air as much as possible.

When man first conceived the idea of rescuing the balloon from the indignity of being a mere sport of the winds, and of supplying it with motor and screw propeller, he at once realised that its shape could be no longer a sphere, but that it must be elongated. Long before M. Giffard made his first practical experiment in 1852, in designs and visionary projects of navigable balloons we find the adoption of an elongated form. In a paper dealing only with practical work, it is expedient to deal only with navigable balloons that have been up in the air, and so we will neglect these earlier visions of what was to come, and begin with the work of the Parisian, Giffard, in 1852. In the illustration on the screen it will be seen that his gas bag was symmetrical, elongated and pointed at both ends (picture shown). This double tapering he thought to be the best way of diminishing the resistance. In this first balloon, M. Giffard adopted in his gas bag what may be considered prudent proportions of length to diameter, viz., about three times the diameter, his exact figures being:—

Diameter of envelope in widest part . . .	12,00 metres.
Length of envelope .	44 ,,
Length in diameters .	3,66

We are not now concerned with the other engineering details, but the illustration on the screen shows so clearly the special light steam engine and boiler which supplied the motive power that I may as well point it out to you. M. Giffard ascended in this balloon on September 12, 1852, in a strong wind, against which he could make no way and had to be content with circular movements and lateral deviations.

He did not make any second attempt with this balloon, and therefore there was little in regard to quantitative results achieved. It may, however, be mentioned that its speed is estimated by M. Chanute as 6·71 miles an hour. In 1885, M. Giffard made a second balloon, in the construction of which he neglected the precaution of right proportion of length to diameter.

The figures being:—

Diameter in widest part .	10 metres
Length	70 ,,
Length in diameters . .	7

The result was that the balloon was so unstable, and its oscillations so violent, that in descending it escaped from its net.

The next picture shows you the navigable balloon devised by the Brothers Tissandier in 1884 (picture shown), and you will notice that their gas bag was as to shape on the lines of that of Giffard's No. 1, symmetrical, and pointed at both ends.

The following are the dimensions:—

Diameter in widest part .	9,20 metres.
Length	28 ,,
Length in diameters . .	3,05

The Brothers Tissandier do not appear to have made any definite return journey, but they claimed that they held their own against a wind force of 3 metres a second.

Satisfactory quantitative results for basis of comparison may, however, be said to have been started in the next experiments with navigable balloons in 1885, by Messieurs Krebs and Renard, on behalf of the French War Department.

Their experiments were noteworthy on two accounts. First in that, by means of elaborate researches, they arrived at what would seem to be the best shape for the gas bag; and, secondly, that out of seven ascents, five return journeys were made to the place whence the balloon started.

Now regarding shape (diagram shown), the gas bag was dissymmetrical, being made very much in the shape of a fish or bird, its master diameter being near the front, and the diameters then diminishing gradually to a point at the back.

The following were the dimensions:—

Diameter at widest part .	8,40 metres
Length	50,40 ,,
Length in diameters . .	6,00

The last figure quoted would seem to indicate that the gas bag was dangerously long, but in fact the balloon appears to have been remarkably steady on account of the minute precautions taken to counteract the instability produced from an excessive length.

Any device which modifies pitching at the same time lessens the loss of speed resulting from the resistance of the air, when the airship is moving at an angle. A direct means of reducing pitching is the dissymmetrical form given to the balloon by placing the master diameter near the front. The resistance of the air falls on the front surface, which in this dissymmetric form of envelope is much shortened, while the compensating surface at the back is augmented. Many experts are of opinion that by this form of envelope, Messieurs Krebs and Renard came nearer perfection than any other navigable balloon constructor.

M. Octave Chanute in a paper read before Section of the American Association for the Advancement of Science, states that no better shape for a navigable balloon has yet been devised, and adds that subsequent experimenters, who have wandered away therefrom, have achieved inferior results as far as the co-efficient of resistance is concerned. Whether or not M. Santos Dumont has been lately influenced by the remarks of M. Chanute or not, it is remarkable that in his later airships he has been reviving the shape designed by Messieurs Krebs and Renard, but of these we will speak later on. My object in this paper is chiefly to impress upon the members of this Society the decided views of experts, as to the shape of "La France," in hopes that some discussion on such an important point may be elicited. Perhaps some may give us reasons for the wandering away from the apparently better shape.

In reviewing the work of Messieurs Krebs and Renard, we are bound to admit that considering the small motive power they had at command from their bichromate electric battery, which has been estimated at 8 or 9 horse power only, the airship made a very creditable record. It can, in fact, be well compared with more recent experiments, inasmuch as with its feeble motor it did rather more as far as the wind force was concerned than the monster balloon of Count Zeppelin in 1900. This, from its vastness rather than by its efficiency, excited the admiration of the world. The picture now shown is from an instantaneous photograph of the navigable balloon "La France," pursuing its aërial course above the Pont du Jour, Paris, and taken from the Laboratory of Physical Astronomy at Meudon, a photograph of which appeared in *Nature* shortly after the experiments, and which the Editor kindly gave me permission to use (view shown).

Very carefully prepared maps were made at the time of the journeys of the airships. The map I select to show you gives three journeys, two out of which were return ones. Here we have the journey of August 25, which was abortive as far as a return journey was concerned (map shown). The dotted line represents the return journey of September 22, 1885, when a journey was made from Meudon to Paris and back again. On this day the wind was blowing at a velocity of from 3 to 3,50 metres a second, which it is true only represents what we should call a calm day, but the airship of Count Zeppelin did not combat any greater wind force.

Naturally the question is asked if it was the better shape of the balloon which was responsible for making up the deficiency as to motive power in the case of the balloon "La France." M. Chanute attempts to answer this question in another article in *Cassier's Magazine*. He says: "In each case the power of the motor was the maximum available with the surplus lifting power at command, but the shape also influenced the speed. Count Zeppelin would have performed still better if he had imitated the fusiform shape of the French balloon of 1885. The resistance of this was given by Renard as $R = 0{\cdot}01685\ D^2\ V^2$ in metric units, and amounts to $R = 0{\cdot}0006876\ D^2\ V^2$ in British units, in which D is the diameter of the balloon in feet, V the speed in miles per hour, R the resistance in pounds. This amounts to 18 per cent. of that of a thin plane, equal to the longest cross-section in area.

Count Zeppelin having obtained a speed of 18 miles an hour, as stated by himself, the resistance of his ship is

$$\frac{32\ \text{H.-P.} \times 375}{18} = 667\ \text{pounds},$$

which is 34 per cent. of that of a disc 39 feet in diameter, with a pressure of 1·62 pounds to the square foot, this pressure being that due to the speed. The equation for his airship is therefore:

$R = 0{\cdot}001353\ D^2\ V^2$ in British units;

but he might have attained about 22 miles an hour had his shape been the same as that of Renard's.

We must remember that the shape of the Zeppelin airship was really not that of the gas envelope. Count Zeppelin sacrificed the shape to the principle he advanced of making his airship up of 17 separate balloons, supported in an aluminium frame, which was a cylinder with paraboloid ends (diagram shown). The individual balloons were to act as safety compartments. Count Zeppelin seemed to think more of safely balancing his machine in air than of quickly manœuvring it. Possibly the members may like to see a snapshot photograph of the balloon in mid-air, which will show its shape. In order that we may present as nearly as possible the appearance of the great balloon on the occasion of its first ascent—July, 1903—I will throw this picture not on the ordinary material screen, but in space, by means of the aërial

graphoscope—that instrument I invented for showing lantern pictures in space and bold relief without a screen. We thus produce a vision, as it were, of the aërial monster hovering over Lake Constance (representation by means of aërial graphoscope).

Before discussing the subject of the balloon of Messieurs Krebs and Renard I should perhaps state that the details of the aluminium framework which supported the balloons have on a previous occasion been made known to this Society; but it may be remarked that the exterior diameter of the cylinder was 11,30 metres, its length 128 metres, the elongation of the airship in diameters reaching the enormous value of 11. It was the adoption of a comparatively rigid framework that made this greater length possible. Before discussing the subject of the balloon of Messieurs Krebs and Renard, I should perhaps state that Major Möedebeck has pointed out that the first idea of making a navigable balloon bird or fish shaped is due to Häenlein, who designed an airship in 1872, as shown in the diagram (diagram shown). Whether or not M. Santos Dumont had studied the question of the advisability of adopting the form displayed by "La France," at any rate he did not adopt the shape in his earlier airships. In space we see a vision of his No. 4, as displayed to the members of the International Aëronautical Commission in Paris in 1900. His gas bag is more like that of Giffard and Tissandier than that of Messieurs Krebs and Renard. Nor shall we be able to trace imitation of the "La France" in his No. 5 or his No. 6, with which latter he won the Deutsch prize. In this latter balloon his dimensions were:—

Diameter in widest part	6,00 metres.
Length	33 ,,
Length in diameters	5,50

As he took no special precaution to counterbalance the instability of the balloon produced by him of too great lengths in relation to diameter, the stability of this airship was unsatisfactory.

But it may be asked what were the wind forces that M. Santos Dumont combatted when he rounded the Eiffel Tower, so that these may be compared with the wind forces combatted by Messieurs Krebs and Renard. Usually it is a somewhat difficult matter to arrive at the wind forces concerned in a navigable balloon experiment, as the wind forces cannot be estimated on the moving body itself. But in the case of M. Santos Dumont's experiments circumstances were peculiarly favourable for forming an estimate of the wind force, since he circumnavigated the upper portion of the Eiffel Tower, on which the wind forces were taken on all the days of the experiments.

In space I project a vision of M. Santos Dumont in the very act of rounding the Eiffel Tower in his navigable balloon, and you see how he hugged these upper portions near where the meteorological instruments were placed. As I have before told the members of this Society, I obtained from the Meteorological Authorities of the Eiffel Tower a record of the wind forces on all the days of the experiments of M. Santos Dumont, and from a careful study of the charts, I came to the conclusion that M. Santos Dumont navigated his balloon against a wind force of about 5 metres a second. It may be mentioned that in a recent article on the subject M. Santos Dumont puts it at 6 metres a second. Putting it at 5 metres a second, this is a figure not so very much in excess of the wind force of 3,50 metres a second combatted by Messieurs Krebs and Renard, and considering that M. Santos Dumont had considerably greater horse-power than the former, the comparison as to wind force combatted is not so much in favour of M. Santos Dumont as might be expected. But I have mentioned that M. Santos Dumont in some of the later of his various airships has adopted a form somewhat similar to that of "La France." His No. 9 is, as you see, larger in front than at the back, as he calls it; it is egg-shaped (view shown). Certainly the neatness of the execution of his various manœuvres with this airship go some way to show the superiority of this form. This No. 9 was the smallest of M. Santos Dumont's balloons. At first its envelope was only 220 cubic metres, but afterwards it was enlarged to 261 cubic metres. But three of such balloons would be required to make up the balloons with which the Deutsch prize was won. So easy M. Santos Dumont found the control of this little balloon when balanced with the air and driven with the guide rope dragging on the ground that on one occasion he was able to steer the balloon through the Paris streets by night and alight at an altitude of the house tops on either side and land at his own front door. On another occasion he says he trusted a young American lady to go up alone in this balloon, and the enterprising damsel, inexperienced as she was, without difficulty navigated the dirige-

able balloon from M. Santos Dumont's station at Neuilly St. James to Bagatelles.

It is interesting to note that M. Santos Dumont has adopted a similar egg-shape for his most recent airship, in which his hydrogen is to be heated at will for obtaining lifting and sustaining power (pictures shown). But to pass to other types of recently devised airships, we see that the bird or fish form of gas bag is neglected.

In space we produce the image of the unfortunate Severo airship, which ascended but once and had a brief existence. For, a few moments after its ascent, the gas bag exploded, to quote the words of an ear-witness, like a crash of thunder, with tragic consequences to inventor and engineer. In this construction the shape of balloon proper was subordinated to novel engineering features, viz , to combination of balloon and car in one melon-shaped symmetrical body, through the centre of which passed longitudinally the shaft which revolved the propelling screws at either end. The screws were therefore in the position to propel the whole system, and not the car only. The shorter life of the Severo balloon gave no opportunity for quantitative results which might indicate whether the advantageous position of screws counterbalanced the less advantageous shaped gas bag.

Other airships have been devised by Baron de Bradsky and Messrs. Spencer (pictures shown). The fatal disaster to the De Bradsky airship a few minutes after its first ascent puts it out of quantitative comparison. The airship devised by Messrs. Spencer has been seen by many of us, and has made journeys in the air. As Mr. Spencer is present I will leave him to give us any details of his airship he may think fit. Lastly I put before you a diagram of the Lebaudy airship No. 1 (diagram shown).

The following are its dimensions :—

Diameter in widest part	9,80	metres.
Length	53	,,
Length in diameters	5,60	

There can be no doubt that this airship and its successor No. 2 can show the best all-round record of any navigable balloon yet devised both as to length of journeys, stability, and wind force combatted. Its shape, though dissymmetrical, is, however, obviously different from that of "La France," but the greater comparative success of this airship in having carried out longer return journeys than other airships, having traversed as much as 65 kilometres in one journey, and having overcome greater wind forces, estimated at 10 metres a second, does not in itself prove that its shape is superior to that of the balloon "La France," inasmuch as its motive power was 40 horse-power, and the power is applied in a more favourable position. I forebear now giving further details concerning the Lebaudy airship, as an author is preparing a special article on this airship for our journal. I will merely show one more picture of the airship, depicting its deck and crew.

In conclusion I would suggest that, though theory undoubtedly points to shape of "La France" as being the model for evading resistance, still it is imperative that the question of shape should be decided by comparative experiment on a large and liberal scale. Such experiments are, however, necessarily expensive and beyond the reach of most individuals and even of societies. To Governments, however, they are not impossible, since large sums of money are annually spent in the endeavour to perfect national means of defence. Has not the time now arrived for a more liberal endowment for experiments to develop the "service of the air?" This country can now boast of the finest war observation balloon in the world, but has not the moment come when some kind of navigable balloon could be added to our national aërial resources, even if it could only be used in calm or moderate winds? Have not great battles been fought on windless days? When a town is besieged for a long period, are there not many days of becalmed atmospheres when a navigable balloon as we now have it could take out letters and individuals to some predetermined spot? In urging greater activity by the powers that be, I do not for one moment wish to suggest that the various balloon departments of the world have not done their level best to make their limited means go as far as possible towards improving the balloon services. I can speak from personal experience, owing to the pleasant connections I have had from time to time with the various balloon departments of several nationalities, including our own, in connection with electric balloon signalling, and invariably the officers I have met in charge of the respective departments have been men of worth, enthusiasm, and devotion to their cause. What I do urge is that in consideration of marked progress by individuals in aërial navigation in recent years there should be a proportionally greater increase in the funds put aside for Government aërial research.

The PRESIDENT: I think that we have just heard a very interesting paper. It is one that brings forward a subject of much importance as to the shape of the airship. If the airship is to be an appliance which we are to use in the future it is of the utmost importance that we should study the best shape from practical experience. I have recently, when I was over in America, seen a good deal of the practical working of what we may call airships. I say what we may call, for I am afraid they were none of them, as I have explained to you before, at all a success. Still it was interesting to see what could be done; they were merely experiments. As regards the shapes of those I saw there, they were all rather of the cylindrical type with pointed ends. I quite agree with Mr. Bruce about the Government experiments. I think they ought to devote more money to making experiments in this line in order to ascertain the best shape of an airship, because the Lebaudy machine has shown us what can be done with an airship. It has gone up on many occasions when a fairly strong wind has been blowing, and fairly combatted that wind, and if we only had such machines in time of war there is not the slightest doubt they would be of the greatest benefit to the army which used them. And for that reason I hope that we shall have more experiments. I know there are more to be carried out this year at Aldershot, and I hope they will have very good results.

Mr. SPENCER said that as to shape, much might be said in favour of having the best shape for the ends in view, but possibly we had not arrived at a point where we have made so much progress that we can really discuss with advantage the absolutely very best lines. With regard to shape, however, the Renard and Krebs shape had undoubtedly appealed to him from the first as being one of the best lines. This fact, however, has to be taken into consideration, that the gas-bag has not only to have very excellent lines for being forced through the air, but it has another main consideration; it is to be the means of carrying a weight into the air. Therefore a shape must be adopted that will contain the largest capacity of the hydrogen or coal gas used. With that end in view the first airship his firm designed in 1902 was, in his opinion, very similar to the Renard and Krebs shape. It measured 75 ft. long; at one-third from the front it had its greatest diameter of 20 ft.; at half it gradually tapered to 19 ft., and then tapered to a point at the end of another 25 ft. That held about 18,000 cubic feet of hydrogen. It made a whole season's experiments in the grounds of the Crystal Palace and eventually one flight over London and another over Blackpool. But on those long-distance journeys there was no effort made to return to the Crystal Palace. Neither, except in an absolute calm, would such a return journey have been possible. In the following year they designed a balloon on exactly the same lines, but of greater capacity; greater length and with a petrol motor of 24 h.p. In 1904 they fitted their airship frame to a coal gas supporting vessel, and went back to the Giffard shape, which had plenty of bulk and supporting power. It, moreover, was very successful in being directed in any course that was wanted.

Mr. ALEXANDER said he was pleased to say something about the Zeppelin airship, as he was one of the assistants there. Unfortunately the steering gear broke down very shortly after the airship started, and they could not get any very reliable results with the screw propeller. The screw propeller has everything to do with a navigable balloon. If you use large propellers of large diameter revolving at slow speed facing the wind you get a certain thrust. If you use propellers revolving at a high speed you do not get the same thrust, the reason being that the wind blowing into the propeller causes a small one to lose grip of the air, whereas the large one does not. That seems to be a very important point with regard to navigable balloons.

Colonel FULLERTON said he thought he might suggest one thing which would be a help in testing as regards the shape of the balloons, and that was by making models and dropping them from a height of 50 or 60 feet. If the models were all of the same weight it would be a fairly good test.

Mr. ALDERSON said that, regarding the estimate of the speed of the Zeppelin airship, given by Count Zeppelin himself as 18 miles per hour, he thought this a considerable exaggeration. He thought Mr. Alexander would be able to corroborate his statement that the trials over Lake Constance were at the average speed of 3½ miles per hour. He would like to thank Mr. Bruce for the very beautiful instrument he had shown them—the Aërialgraphoscope, which had given them in space the very beautiful photographs they had seen.

Mr. ALEXANDER said that regarding the

speed of the Zeppelin airship there was no doubt that for a few seconds its speed was 18 miles an hour.

The HONORARY SECRETARY said that he had received a letter from Mr. Peter Williams, a member of the Society, regretting that he was unable to be present and take part in the discussion on this paper, for he had himself designed a navigable balloon. Mr. Williams had, however, kindly sent drawings of the proposed construction and a description of them, which had been placed on the table for members to inspect.

Automatic Stability.

By E. C. HAWKINS, J.P.

The title of my paper should really have been "Stability in Ordinary Conditions of Wind near the Ground," to indicate that the stability about which I want to talk here to-night is not the equilibrium of a machine in calm air, or in an unfluctuating breeze (if there is such a thing), but the ability which a machine must have to remain stable under ordinary conditions of wind most days in the year. Although my ideas on feathering fans are brought in as one way of meeting the conditions which have certainly up to the present not been provided against in any experiment, I by no means hold by them if any better way could be devised for this vital purpose. Now the ordinary conditions of a breeze near the ground have been ably described by Sir Hiram Maxim and Professor Langley. To put it shortly, an airship when near the ground must be prepared to take a gust of unknown strength, from any direction, or any part of it. Now, in the ordinary fixed wing machines it is obvious that in very many ways gusts, if there is not sufficient room for recovery, would be fatal. To take one case only, the aëroplane will probably be built to make its most efficient angle with the horizontal fore and aft perhaps 3°; if, therefore, a gust of 10° meet it from the front a thirty or forty foot drop would be quite a likely thing before recovery. Precisely the same accident might happen to either wing alone. The whole question of stability with the fixed wing type of machine has not been attempted by any but the users of gliding machines. Lillienthal's and Pilcher's gliders were perfectly stable, from the centre of gravity below centre of effort, yet even these had to provide for moving their centre of gravity to counteract gusts, yet that was by no means sufficient. Also, I believe Professor Langley's machines, after flying horizontally for some distance, have flown full speed into the water from deflections of their wings. To sum up, in my humble opinion a fixed wing aëroplane can never be a safe machine, except on a dead calm day, or at considerable distance from the ground, or any obstruction. Now every flying creature is able to alter its wing surfaces instantaneously to altered wind currents, and that it has to so alter them continually on a gusty day is obvious to any observer. Now this alteration of wing surfaces to altered conditions instantaneously has to be governed by an instinct evoked in them by the continuous practice, failures, and successes of untold ages. It is difficult to see how this instinct to instantly alter wing surfaces can be obtained in order to do this work by hand. It must therefore be automatic, and the pendulum and gyroscope offer themselves as likely aids. Now the surfaces and masses of large wings would be extremely unwieldly things to move and regulate quickly without some very powerful form of servomotor and a corresponding degree of complication. Now I am going to suggest, as a possible means of easily altering the direction of lift or effort with a minimum of power, the use of a certain type of feathering fan. In effect this is simply the splitting up of the aëroplane into a number of surfaces, carried in a rotary direction, each of which surfaces is, at the particular point it happens to be and direction it happens to be travelling, at precisely the exact angle with the air on which it is acting, to do its work with the greatest efficiency. I am quite aware that this form of fan has been constructed more than once, in its extremely inefficient forms, but the causes of this inefficiency can be easily seen and avoided, enabling the ideal motion of the aërocurves to give something approaching their theoretical efficiency, which is considerably higher than that of the very best form of screw. I should like to say that this fan was, I believe, invented by a Mr. Waelde, twenty years ago, and is now a hardy annual at the Patent Office.

The main object at present to be obtained is a machine which will rise from the ground without a long run or impetus from a prepared track, which will remain stable laterally, and fore and aft, in an ordinary variable breeze, will rise or fall on an incline according to the will of the aëronaut, and

which when brought to earth on a downward incline will retard its horizontal speed powerfully and effectually when within a few feet of the ground.

This specification is intended to point out in a humble and undogmatic way a possible line of evolution, in the present state of knowledge, from the motor-driven balloon to the true airship; not a mere helpless screw-driven dart, but one which by all the laws and formulæ in which we at present put our trust should behave in the aforementioned desired manner.

The main features of the fan itself have been described so frequently at different times, notably Patent Specification No. 9108, 1896, Waelde, and No. 19282, 1889, Count D'Avet, that it is unnecessary to describe them here. The chief points, however, of this invention depend on the ability of fans of this type to have their axis of effort altered by simply revolving the gear controlling the two to one gear (hereafter called the controlling gear) through a proportionate angle. This effect is comparable only with a screw propeller on a shaft which can be rotated radially through a circle. This ability enables stability to be obtained in a gravity controlled airship or aëroplane, in one way as follows:—

In the drawings Figs. I. and II. represent diagrammatically a pair of such fan wheels mounted on a common shaft with the method of ensuring stability. Figs. III., IV., and V. possible applications of such fans to complete machines.

In Fig. I., of which Fig. II. is a side diagram, A and B are two rotating fans on the same horizontal shaft S. D and C respectively are their controlling gears. E is a weight or pendulum hanging from a bevel wheel F which gears into two bevel wheels keyed on horizontal shafts, which in turn gear into D and C. On E therefore swinging to one side or the other, D and C can be made to move through corresponding angles in opposite directions. On the shaft S therefore departing from the horizontal, it is obvious that A may be made to pull up, and B correspondingly to pull down, or *vice versa*, automatically.

In a similar way if the propeller shaft S (supposing the propeller to be at the forward end of the machine) drops relatively to the usual plane of the whole machine, E will swing forward, this, carrying bevel gears and all with it, may cause both A and B to pull up together, raising their end of the machine in comparison with the other and restoring equilibrium, also the reverse will obviously take place in the case of the equilibrium being disturbed in the opposite direction. Two fans therefore thus governed form a propeller as efficient as the ordinary screw, yet would keep an airship on a level keel fore and aft or sideways. Owing, however, to the great differences of pressure on each side of the axis of each vane, when travelling horizontally, the controlling force used to alter the gear instead of being merely enough to overcome friction, must be fairly considerable, the weight or pendulum E may then be the whole, or more or less of the mass of the engine, passenger, or the like, hung on rods free to swing fore and aft to govern the fore and aft stability, and in the case of the lateral stability being controlled from the same pendulum, in certain cases to swing slightly sideways.

You may then have a form for example as Fig. III. or Fig. IV. (A) in each case is a side diagram. (B) is a diagrammatic view from above.

Fig. III. is a diagrammatic plan of the present idea of aëroplane. K is a large somewhat unwieldy surface, driven horizontally by a pair of fans A and B on the shaft S as before described, the shaft S being of course driven from the motor at E. Since S is in this case at the stem of the machine, the fore and aft motion of the pendulum E (where is also the motor and aëronaut) must be reversed before moving the bevel wheel F fore and aft, which can easily be done, in one way by interposing an extra toothed gear. It is then obviously possible to keep this type stable and at the same time propel it.

Fig. IV. is a type using the same automatic stability arrangement, but has evolved considerably from Fig. III., in that the main sustaining effort is thrown on the propellers. In Fig. IV. (A) the fans A and B, when travelling horizontally on an even keel through the air, are arranged so that the upper vane I is always at a small angle with the horizontal, acting therefore as an aëroplane, only with the difference that it is meeting the air at more than double the horizontal speed of the whole machine. Since I is tilted so must J and M be slightly tilted from the angle of 45° at which the vanes would be merely propelling, the result being that they also act to a very considerable extent as aëroplanes or lifting surfaces. Even N, though almost entirely a propeller, yet has a small lifting effect. You have then the ideal form of easily controlled

Fig I.

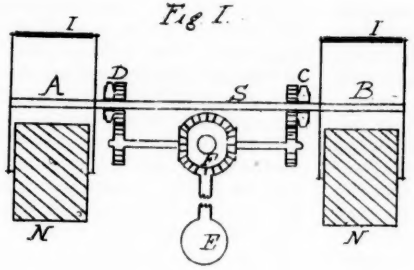


Fig II

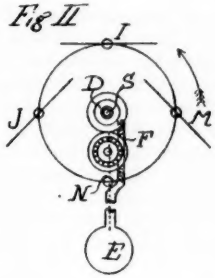


Fig III (A)

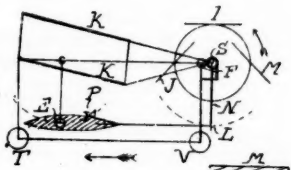


Fig IV (A)

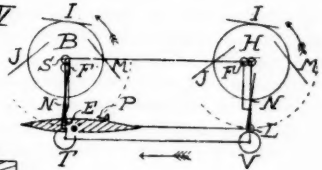


Fig III (B)

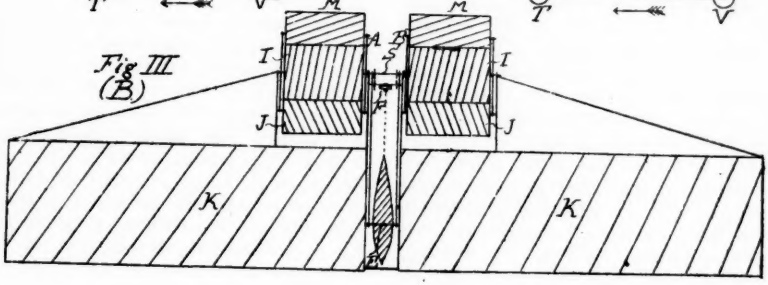


Fig IV (B)

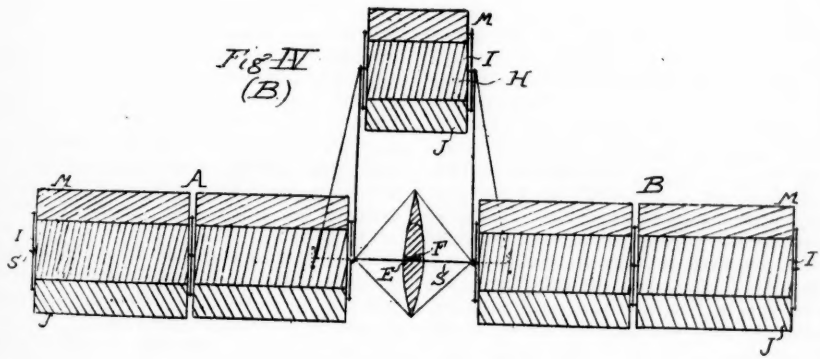
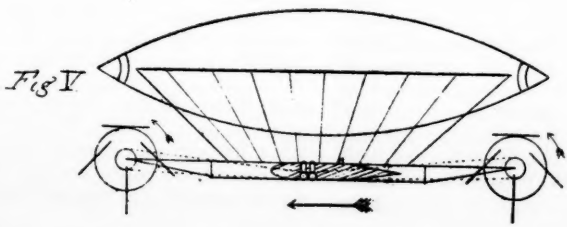


Fig V



lifting surfaces and propeller in one, all its parts in rapid motion and therefore less controlled by eddy currents and using the energy of its motor over a wide and deep stratum of air.

A simple application of the same advantages of this propeller may be obtained as Fig. V., a balloon carrying two of these fans fore and aft. This type could in the aforementioned ways be kept stable fore and aft, could lift from the ground when considerably heavier than air, and yet when travelling horizontally, if with a total mass considerably heavier than air, travel much faster than the machines with the naturally larger balloons. This heavier than air propelled balloon by the assumption of double propellers in line at one end as the balloon got smaller, and the lateral stability less, would by successive and comparatively safe stages arrive at Fig. III. or perhaps Fig. IV. Since Fig. III. is practically the well-known Langley type of aëroplane with the addition of stability ensuring propellers, I will endeavour to describe Fig. IV., whose details may be taken to apply to Fig. III. as far as they go. The object of this construction is not only that it may be automatically stable in eddy currents and almost uncapsizeable, but that it should start from the ground without a long run, the first acceleration being obtained by gravity, but also on alighting with the motor in action should automatically retard itself almost instantly, and in the case of the motor stopping in mid air, to glide to earth gently and safely, though the action of the aëronaut will be needed to prevent it landing with too much horizontal speed. In Fig. IV. A and B are two propeller sustainers on the same shaft S, but aft and between them is a third propeller H, which may be in a simpler case a simple aëroplane. Hanging from the fixed frame connecting the shaft S and the shaft of H is the parallelogram S E L H, E being the car containing the motor and aëronaut. The point E being somewhere near the centre of gravity of the car and also the shaft of the motor, which can therefore drive the shaft S independently of the swing of the car. E and L are therefore free to swing fore and aft on S and H. The two forward supports are allowed a slight lateral swing in the bearings, sufficient to act on the bevel gear which controls the sideways equilibrium as before mentioned. The mass of the car acts as the aforementioned pendulum or balance weight.

There are then three forces acting on this pendulum—1st the force of gravity tending by means of the aforementioned appliances to keep the whole machine in equilibrium; 2nd the angular position of S E is altered to a certain extent from the vertical by the pull of the motor from the shaft E to the shaft S; this tends to draw E forward more or less on S. It follows that since that will tilt the vane I more from the horizontal, the more E is pulled forward the more A and B will tend to pull up. However, since the angle through which E is pulled forward by the thrust of the motor can be varied by altering the leverage, and the angular position to the horizontal of I by so setting the controlling gears of A and B, the two can be so combined and related that the pull forward of E is just the right amount to tilt the vanes of A and B the correct angle to sustain and travel when the motor is at its governed speed and power. On the stopping of the motor, this pull being gone and the wheels A and B free to revolve, the vanes of them are then set automatically to travel down an incline at a speed which can be controlled by altering the angle S E L by the aëronaut, who can descend in safety if able to keep his head. The third force acting on the pendulum is the only thing for trouble, *viz.*, the inertia of the mass on gusty or puffy days, when it will be unsafe to travel close to the ground without room for recovery, until a very large amount of skill has been obtained by constant practice. The machine may be controlled as follows: a wheel the turning of which controls the steering is placed in front of the aëronaut at P. This wheel can be pushed away or pulled towards the aëronaut, making wider or smaller, by suitable gear, the angle S E L, and so causing the machine to mount or descend an incline.

A rudder of the ordinary vertical type may be attached to any standing part of the rigging of the machine, and connected up to the steering wheel at P. In practice, however, it will possibly be found that sufficient dirigibility may be obtained by manipulation of the lateral position of the car, so purposely disturbing the lateral stability of the machine and thus causing it to turn. A small accessory, but an absolutely essential one in any aëroplane, is a small light vane held up to the wind by a spring, the amount of movement of which enables the aëronaut to judge his speed through the air, and alter his gear

accordingly, all the ordinary land marks of speed, but the feel of wind on the face, being lost. In order to avoid a lengthy run to gain the necessary acceleration to start, which would make it almost impossible for an aëroplane to rise from an unprepared surface, except against a breeze, the car containing motor and aëronaut may be raised on its swing arms S E and H L, to a position level with or even above the frame S H, the whole apparatus being meanwhile supported on light fixed legs running on wheels T and V, from which position it may be let free, swinging down to its proper vertical position, at which it engages with the balance controlling arm of F.

It thus obtains for the great mass of the machine a velocity which renders it easy for the whole machine to acquire velocity sufficient to rise almost at once. This arrangement necessitates no further increase of weight. Another small detail of a few pounds weight is a trail rod similar to a sprag, which may be let down before alighting, which on touching the ground and dragging back throws up the forward vanes by rotating D and C, making A and B retard and counteract all forward velocity in as short a space of time as possible, thus ensuring a safe descent automatically.

Each vane of each fan may, if desired, consist of two or more parallel tiers of surface, and may be constructed of resilient material such as fabric under tension, able to take up different curves varying with the pressure on its surface similar to a sail.

Now, it has been suggested to me that the pendulum is an extremely unreliable arbiter of the horizontality of an airship, owing to the effects of acceleration and retardation on its inertia. I am perfectly willing to grant that the pendulum does by no means always hang vertically, but that it does hang in line with the forces which are acting both on it and on the airship, not necessarily always that of gravity alone, keeping the airship always more or less at a certain angle in relation to those forces. I would go further and am convinced that it would do more than is possible to be done with the gyroscope, and make the machine behave exactly like the bird in all its methods. To thoroughly understand the difference, it is only necessary to imagine a gyroscopically-governed bird, whereas the fact that the bird is influenced in the angles of its wing-movements to a great extent by inertia can easily be proved by observation. While on the subject of pendulum-control I should like to mention that I have constructed a gliding machine model of the superposed aërocurve Chanute type, governed in this manner, that not only is it wonderfully stable in a gusty wind, and thus extremely unlike the fixed plane model, but (and this fact I want to emphasise), it also consistently takes appreciably longer in reaching the ground in a gusty wind than in a calm.

The PRESIDENT: I must say this is a very interesting paper, because one can at once grasp the fact that the author of it has thought out all his details very carefully. The subject of a novel and rather complicated type of flying-machine is, of course, one on which there may be a great variety of opinions, and I always think it is extremely difficult to make any definite statement as to it. I have often been asked my opinion on a certain type of machine, and I always say it is extremely difficult to give any opinion whatever until you see something of the working out of the details. But so far as I can see, the whole idea seems to be very fairly conceived and I cannot at once point out any objection that I see to the whole of the device. It appears to be rather complicated, and I cannot help thinking our first machines ought to be something of a very simple type, but if the simple type won't work, we shall have to get something more complicated. I do not know whether any gentleman would like to ask any question or make any remarks on this paper.

Dr. BARTON said the paper brought forward one or two questions he should like to ask. It always seemed to him if we could only get a feathering propeller that works satisfactorily, the probability is we should get a far greater thrust than with a screw propeller. He should like to ask the author if he had any idea of the thrust he could get with a feathering propeller. He had seen one or two. He had seen the one he mentioned, and it certainly seemed to give a good thrust, but the mechanism which is required to manipulate these feathering propellers is somewhat complicated, and it seemed to him a great deal of the power is taken up in friction and gearing. If Mr. Hawkins had any method of utilizing a feathering propeller, he thought it would be interesting to know about it, and also if he had any idea of the approximate thrust, because there is not the slightest doubt that if such a machine

could be governed by means of a pendulum, it would be of extreme use in making machines rise or fall or for stability purposes. If they were moved slightly up or down, the pendulum would at once alter the gear and so bring the planes into different operation. He thought it would be very important if it could be managed in a proper manner. We are not altogether successful with the amount of thrust we get at the screw, and he should like to know if Mr. Hawkins had any experience with the propeller and if he could give them any idea of the approximate thrust.

Mr. LEES said he should like to ask whether any experiment had been tried with a model made on the plan shown? It seemed to him the method of using a pendulum was a very suitable one, and one which might actually be used with a gliding apparatus. The gliding apparatus used at the St. Louis Exhibition was balanced by a pendulum, the pendulum being Mr. Burrough's body. Therefore, if a pendulum could be used, it would certainly help us to overcome the effort of coming down, and do it safely. If we cannot manage to balance the machine in some way or other, he was afraid we might get a machine that will lift itself, but it will never be a practical one. He hoped the author would continue his experiments and test them on a model, so that one could see whether it will work or not.

In reply to a question as to whether any details could now be given as to the construction of the model that is governed gyroscopically,

Mr. HAWKINS said: I have made some experiments with gliding models—in fact, I have made several of them with fixed plain gliders of different types—and I got very satisfactory gliders in calm air or inside a barn. But when I tried them in the open air without choosing my day and time, I found them smash up after the second or third time very often. They would not come down straight; they would get tilted up and have a big drop, and very often the drop occurred when they were near the ground. With regard to the governed glider—of course, pendulum-governed—if the pendulum be analysed, it will be seen it is merely an aëroplane held to the wind by a weight. It is much the same as a weight below the centre of effort, only the weight is to be in a position where it has a certain amount of mechanical advantage. With regard to the glider model, I do not want to say too much at present. I have only made one actual good model, and that is smashed up now. I am afraid I tried it rather beyond its endurance. The model was rather a rough one. Since then I have decided to build a succession of models, and hope to arrive at some data worth having. One can easily see that this type is a complicated idea, but one must remember that the ordinary aëroplane is designed for two purposes—lift and stability. This has five features—lift, stability, quick acceleration, automatic retardation, and, fifthly, it should become a glider automatically if the motor stops. That might not be important for anyone but the person in the thing. Also I lighten it to take a corner with the outer wing up, and so avoid any great loss of energy in turning—in fact, it appears to me a pendulum-governed machine acts almost exactly in the way a bird does. In quietly flying it does, especially in turning. About the models I have made of the fan, I have made several, but they have been fairly rough—in fact, the first used up more of its energy in turning than it did on the air. The latter ones have shown a great deal of increasing efficiency, and, of course, it is very easy to work out what the efficiency might be if there were no power used up in turning the ends. Referring to the diagram, when they are made like this, with two bearings supporting a working surface, when any work comes on this surface the result is a tremendous turn in each of these two ends. I found that happened in my machines, and it means a tremendous waste of power. Another tremendous loss is in the turning movement of the fans. You do not get the fans getting their ideal motion. I think my work up to the present, allowing for a certain amount of friction and that sort of thing, shows there ought to be in practice a thrust of something like 67 or 68 lbs. per horse-power. Of course, that is enormous compared with the screw.

Notes on an Aluminium Kite.

BY ALAN H. BURGOYNE.

I have made many kites subsequently, and of many different forms, but always came back to that represented in the photographs before the meeting. It resembles in some particulars that of Mr. Cody, though I had made it long before I had seen or heard of Mr. Cody's kite. The essential

difference is in the wings, where I do away with the eccentric protuberances which he favours. One particular feature I would point out is my employment of steel springs to fly the kite from at the kite-end of the connections. Mr. Cody employs all his springs at the winder end, but I find the double use of springs renders the flight of the kite infinitely more steady.

My aluminium kite was of the following dimensions:—

	Ft.	Ins.
Extreme breadth from tip of wing to tip of wing	12	8
Extreme length . . .	10	9
(Of which the tail took up)	4	0
Wings, width	3	0
,, length	6	0
Tail, width	6	0
,, length	4	0

The aluminium I bought in hollow rods of from $\frac{1}{4}$ in. to $\frac{5}{8}$ in. in thickness. The sides of the three "boxes" were made of eight rods, 6 ft. long and $\frac{1}{4}$ in. thickness. The wing supports were of one $\frac{5}{8}$ in. rod, 12 ft. 3 ins. in length, passing right across the kite and secured by lashings to each "box" in turn. The tube, fore and aft, was also of $\frac{5}{8}$ in., and was wired with strain-eye attachments to all eight box rods. In fact, the strain was distributed evenly from the tips of the wing-rod to the tips of the fore and aft rod, making a tightly-braced quadrilateral.

Two 3 ft. tubes of $\frac{3}{8}$ in. were used as vertical supports, and in the bottoms of these I placed two small wheels, so that the transport of the kite when set up was greatly facilitated.

The tension on the linen was made, not by the usual cross-bracing, but by means of aluminium rods running across each end of the boxes both top and bottom. This system made the kite not only perfectly rigid, but also more easy to take to pieces. The fastenings for these were round brass sockets, set cross-ways. I have taken the kite to pieces and set it up again in under half an hour.

The linen is ordinary shirt-front linen of the finest quality—indeed, it was the most expensive item, for I required a dense texture with a minimum of weight.

The cord I use is "cod-cord," the first 1500 feet being light, and the remainder (12,500 feet in all) of similar type, but much stouter. To relieve the strain as much as possible I had a steel-spring, 6 inches in length, fixed at every attachment, and further had three or four more (according to weather) between the two flying rings. As regards weight, the kite was a marvel of lightness, weighing exactly $12\frac{3}{4}$ lbs., without springs, of course. The reel and methods of control were, and are still, very primitive, since I have devoted all my attention to the kites. To ease the pull on the reel (a large bore reel with clutches), I devised an elastic tension pulley, using an india-rubber door closer, an inch thick, and several pulleys with steel springs.

My highest flight attained is between 10,000 and 12,000 ft. I dare not guess nearer, as I could only calculate by the amount of cord out, and the angle of the the kite. That was with a small ten-feet kite.

The PRESIDENT: It now only devolves upon me to ask you to record your thanks to the readers of the several very valuable papers, which I am sure have been highly appreciated.

Mr. FROST: It is my pleasant duty to propose a vote of thanks to the President, and to thank him for so kindly and generously offering a prize for the best flying model, under certain conditions and considerations. Our best thanks are due to him, and I hope much energy will be put forth to obtain that prize.

Colonel FULLERTON: I beg to second that.

The vote of thanks was carried by acclamation.

Applications for Patents.

(Made in January, February, and March, 1905.)

The following list of Applications for Patents connected with Aëronautics has been specially compiled for the AËRONAUTICAL JOURNAL by Messrs. BROMHEAD & Co., Patent Agents, 33, Cannon Street, London, E.C.

1084. January 19th. JOSE WEISS. **Improvements relating to Flying Machines.**

1140. January 20th. ANDRE GAMBIN. **Improvements in Propellers for Marine and Aerial Navigation.** (Date applied for under Patent Acts, 1901. 3rd February, 1904, being date of application in France.)

3186. February 15th. Frederick Squires Morgan. **Improved means for Directing Air-ships.**

3214. February 15th. Edwin Richard Mumford. **Improvements in or connected with Aerodromes.**

3990. February 25th. Armaud Dufaux and Henri Dufaux. **Improvements in and relating to Aeroplane Machines for Aerial Navigation purposes.**

4699. March 7th. James Mayall. **A new and improved Kite.**

4729. March 7th. Frederick George Paynter and Francis Alexander Barton. **Improvements in or relating to Kites or Aerial Machines.**

4920. March 9th. James Jones and Charles Francis Jones. **Improvements in the construction of Air-ships.**

5341. March 14th. Reginald Cameron Brown. **A method of Propelling Air-ships and the Construction of Air-ships therefor.**

5749. March 18th. Joseph Barclay. **Improvements in Flying Machines.**

5991. March 21st. Theodore Henry Stringer and Alexandre Liwentaäl. **An improved manufacture of Propellors for propelling Air-ships and like purposes.**

The Aëronautical Section of the Milan Exhibition.

The following particulars have been received of the Classification of the Aëronautical Exhibits at the forthcoming Milan Exhibition. These Exhibits will be included in the Section dealing with general locomotion under the following categories :—

1.—**Materials for Construction of Balloons.**
2.—**Ordinary Balloons.**
3.—**Airships.**
4.—**Flying Machines.**
5.—**Motors.**
6.—**Hydrogen and Oxygen.**
7.—**Meteorology.**
8.—**Various.**

The General Secretary is L. Sabbatini, and the President of the Executive Committee A. Salmoivaghi.